ENERGY ENGINEERING ANALYSIS PROGRAM (EEAP)
CORNHUSKER ARMY AMMUNITION PLANT
GRAND ISLAND, NEBRASKA

EXECUTIVE SUMMARY

PREPARED FOR

THE DEPARTMENT OF THE ARMY

OMAHA DISTRICT
CORPS OF ENGINEERS
CONTRACT No. DACA45-81-C-0017

BY

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FINAL REPORT

MARCH 5, 1984

DEPARTMENT OF THE ARMY
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CORNHUSKER AAP
GRAND ISLAND, NEBRASKA

EXECUTIVE SUMMARY

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CORNHUSKER AAP
GRAND ISLAND, NEBRASKA

PREFACE

Location

The Cornhusker Army Ammunition Plant is located in southeast central Nebraska, approximately 6 miles west of Grand Island, Nebraska (population 35,000), and about 70 miles north of the Kansas-Nebraska state line. CAAP is located on 11,936 acres of flat land about 1,841 feet above sea level.

The CAAP is contractor-operated by the Mason & Hanger-Silas Mason Co., Inc.

Buildings

The plant consists of approximately 430 buildings which house production, support, and administrative functions. There are, in addition to the above, 225 magazine buildings. There are also 263,700 square feet of interconnecting ramps.

Approximately 25% of the buildings, plus 100% of the ramps, were surveyed. The square footage of the buildings surveyed range from 1,100 to 65,540 square feet. At the present time, the production facilities are on inactive status, and have been since 1974.

Plant History

Construction of the plant began in early 1942. A fourth line was added and construction was completed in March, 1945. The plant was shut down in September, 1945.

Reactivation began in late 1949, with Mason & Hanger-Silas Mason Company operating the plant,starting in early 1950. Reactivation was completed on December 1, 1951. Operation at the plant continued throughout the Korean Conflict, until it ceased in 1956.

The plant was then placed on standby status and maintained and leased out until September, 1965, when reactivation was again begun. Production began in early 1966 and continued until 1969 when a cutback in production schedules began and a layaway of lines started. The plant ceased production and was laid away in early 1974. The plant was placed on standby. Since that time, most of the production equipment has been removed and many of the buildings have been leased to private industry, as well as individuals.

Plant Status

The plant is currently on inactive status. Maintenance, renovation, and custodial services are being performed to insure resumption of production within prescribed time limitations.

CORNHUSKER AAP
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ES-1.0 AUTHORITY FOR STUDY

This study is being performed and the resulting report prepared by Energy Masters Corporation of Overland Park, Kansas, under Contract No. DACA45-81-C-0017, as issued by the Corps of Engineers, Omaha District. *Contract Date 7 April 1981 and amended to include Cornhusker AAP.

ES-2.0 PURPOSE OF THE STUDY

The purpose of this study and report is to develop a systematic program of energy consumption reductions in compliance with the stated goals of the Army Facilities Energy Plan (AFEP). This report will:

- Develop a systematic plan of energy conservation opportunities (ECO's) that will meet the objectives of the AFEP.
- Develop a coordinated facility-wide energy study.
- Prepare DD Form 1391 and Project Development Brochure (PDB's) and required documentation for feasible projects.
- Include all practical energy conservation methods and determine economic feasibility in accordance with given guidelines.
- List and prioritize recommended projects.

NOTE: No previous studies have been performed at CAAP.

*A copy of the Scope is included in the Appendix

This report will summarize ECO's developed under Increments A, B, F, and G. Backup data PDB's and DD Form 1391 for Increments A, B, and G are included in Volumes I and II of this report. ECO's developed as part of Increment F are also summarized with backup data in Volume III. DD Form 1391 and PDB's are not required for Increment F. Increments C, D, and E are not included in the scope of this study.

ES-3.0 STUDY METHODOLOGY

Since the study was to be performed facility-wide, and CAAP has been inactive since 1974, some method to determine energy usage during future mobilization had to be developed.

Normally, a study would include a survey of energy-using equipment, i.e., hours of usage, motor horsepower, amperage, steam consumption, etc. Assimiliating this data presented an immediate problem: Most of the process equipment has been removed, and most of the utilities turned off. Buildings are leased to private firms and individuals for manufacturing and storage. These tenants supply their own utilities, heating, and A/C plants, and production equipment.

CORNHUSKER AAP
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The alternate energy usage projection used for plant mobilization was based upon recent historical data. A review of this data revealed that:

1. The FY 1969 was the highest use of energy in recent production history. See ESBG-1.

2. The FY 1969 was not a year of maximum production.

3. Natural gas was used in 1969.* No. 2 fuel oil is used as a standby fuel. Fuel oil is also used in small package boilers and furnaces in individual buildings. All of these boilers are currentlu inactive. Residential furnaces are in use.

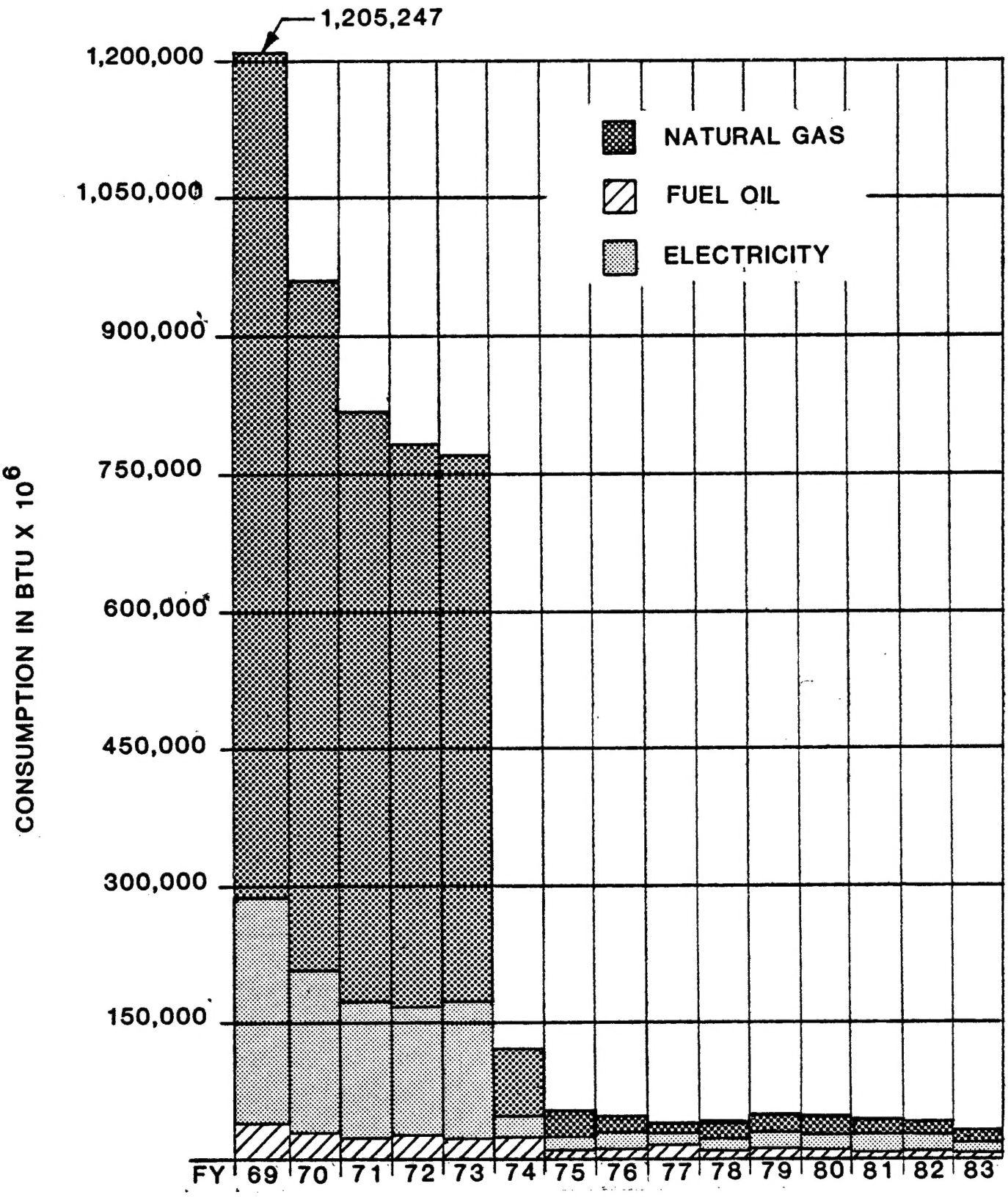
Based upon the available data, certain assumptions could be made about energy usage during mobilization:

1. Gas would probably be the primary source of boiler fuel.

2. Energy usage would increase over FY 1969 usage because of increased production.

For these reasons, the consumption in FY 1969 was increased by 25% to establish a baseline usage assuming mobilization. This usage is, admittedly, arbitrary and could vary, depending upon production levels, equipment efficiency, ECO's implemented, as well as any changes in CAAP's Mission.

*Boiler Houses are gas-fired, with #2 fuel oil as a standby fuel.



ACTUAL FUEL CONSUMPTION IN BTU X 10^6

BAR GRAPH ESBG-1

A Baseline Consumption of 1,505,466 x 10^6Btu/Year was established by this method. This usage included 27,260,636 kwh of electricity and 1,109,675 MCF of gas.

Graphs and tables showing monthly historical and estimated Baseline Consumption can be found in Appendix Volume III, Par. 4.2.4. The projected "Baseline Consumption at Mobilization" on a monthly basis can be found in the Table ES-1 on the following page. This data is based upon escalated historical usage and utility billings.

ES-4.0 ENERGY CONSERVATION MEASURES

Cornhusker has pursued, and is pursuing, an active Energy Management Program in its active buildings. This program has accomplished several energy reduction goals:

- Exterior lighting throughout the plant that is not required, has been turned off.
- Exterior lighting has been changed from incandescent to mercury vapor.
- Insulation has been installed in the ceilings of active buildings.
- Storm windows and weather stripping have been added to active buildings.

BASELINE ENERGY USAGE

ES-1

	ELECTRICITY				GAS			NO. 2 FUEL OIL			TOTAL	
	KWD	KWH	$	BTU X 10^6	MCF	$	BTU X 10^6	GALLONS	$	BTUx10^6	BTU X 10^6	$
NOV	4,716	2,593,800	85,480	30,090.4	58,450	126,205	60,203.5	70,000	63,000	9,709	100,003	274,685
DEC	4,725	2,286,900	79,374	26,529.2	115,400	249,160	118,862.0	62,500	56,250	8,669	154,060	384,784
JAN	4,988	2,863,112	92,797	33,210.8	122,026	263,466	125,686.8	59,891	53,902	8,308	167,206	410,165
FEB	4,894	2,770,004	90,268	32,132.0	143,420	309,656	147,722.6	40,805	36,725	5,659	185,514	436,649
MAR	4,613	2,228,079	77,408	25,844.8	153,869	332,215	158,485.1	37,185	33,467	5,160	189,490	443,090
APR	4,013	2,211,163	72,868	25,647.6	104,634	225,917	107,773.0	25,923	23,331	3,592	137,013	322,116
MAY	4,069	2,180,984	72,653	25,299.6	77,255	166,805	79,572.7	12,581	11,323	1,748	106,621	250,781
JUN	3,919	1,771,388	63,371	20,543.6	62,686	135,351	64,566.6	7,153	6,438	985	86,096	205,160
JUL	3,881	2,204,408	71,808	25,566.4	50,618	109,296	52,136.6	1,889	1,700	264	77,967	182,804
AUG	3,900	2,152,800	70,904	24,974.8	47,893	103,413	49,329.8	2,129	1,916	291	74,596	176,233
SEP	3,844	1,891,248	65,255	21,935.6	55,460	119,750	57,123.8	5,199	4,679	721	79,781	189,684
OCT	3,975	2,106,750	70,503	24,441.2	117,964	254,696	121,502.9	8,275	7,448	1,151	147,095	332,647
TOTAL		27,260,636	912,689	316,216.0	1,109,675	2,395,930	1,142,965.4	333,530	300,179	46,257	1,505,442	3,608,798

- Lighting levels have been reduced.
- Interior night lights have been turned off.
- Night and weekend temperature setback controls have been installed in Buildings S1, S5, S6, S14, S30, CY1 and A12.
- Installed smaller transformers in some locations and shut off others.
- Cut back on domestic water pumping. Placed some pumps in idle status.
- Took various steps to reduce gasoline consumption.
- Installed insulation on domestic water heaters and piping, and reduced water temperatures.
- Closed off rooms and consolidated offices, buildings, and functions.
- Installed individual radiator controllers.
- Installed central air conditioning in place of window units.
- Started installing energy efficient fluorescent lamps.
- Installed fifteen insulated overhead doors.
- Insulated steam and condensate lines in active buildings.
- An employee awareness program is in effect to urge conservation.

Planned and/or Funded Projects include:

- Install three low pressure boilers in shop area to eliminate use of large high pressure boilers.

- Install additional insulated overhead doors.
- Replace additional motor vehicles.
- Install additional ceiling fans.

ES-5.0 ECO'S STUDIED

ES-5.1 INCREMENTS A AND B

Because CAAP is an inactive facility with only a few active buildings, it was determined that projects recommended under Increments A and B should be divided into two categories: those projects recommended for inactive buildings and systems which would have future energy conservation benefits under mobilization; and those projects recommended for active buildings and systems which would have immediate energy conservation benefits.

The list of projects studied is the same for active and inactive facilities, and is summarized in Table ES-2, showing the application to active or inactive buildings. A brief description of each project is shown below:

ES-5.1.1 Architectural

- Install or supplement existing roof insulation to reduce conduction.
- Install wall insulation to reduce conduction.

- Install insulation in crawl spaces.
- Install storm window on remaining windows. This will reduce both conduction and infiltration.
- Replace existing overhead doors that are rotted, in poor condition, and leaking air.
- Install vestibules at high traffic entrances to reduce infiltration.
- Caulk and weather strip existing loose-fitting doors and windows to reduce infiltration.
- Install window shading devices or reflective film to reduce solar gain.

ES-5.1.2 Mechanical

- Collect wasted condensate within each building, and feed by gravity to underground local collection tanks to the main powerhouse. Insulate piping.
- Install steam control valves with zone heating stats and night setback thermostat to control each zone.
- Insulate domestic hot water piping.
- Install economizer cycle with enthalpy control on existing air handling units for "free cooling" in moderate weather.

ES-5.1.2 (continued)

- Insulate steam piping in buildings.
- Add insulation to aboveground steam mains.
- Install an Energy Management Control System,
- Install central air conditioning.

ES-5.1.3 Electrical

- Replace existing incandescent fixtures with fluorescent.

  Install switching and task lighting for maximum benefit of energy use reduction.
- Power factor adjustment.
- Install energy efficient lighting.

ES-5.1.4 Power House

- Install 0_2 trim on prinary boilers.
- Install blowdown heat recovery on boilers.
- Install boiler economizer.

TABLE ES-2

PROJECTS STUDIED FOR CORNHUSKER AAP

PROJECT	BUILDINGS ACTIVE	BUILDINGS INACTIVE	PLANTWIDE	COMMENTS
Insulate Building Walls	X	X		See Volumes I & II
Insulate Ceilings & Floors	X	X		See Volumes I & II
Caulk & Weather Strip	X	X		See Volumes I & II
Install Overhead Doors	X	X		See Volume I
Install Storm Windows	X	X		See Volumes I & II
Install Vestibules	X	X		See Volumes I & II
Insulate Dom. Hot Water	X	X		See Volumes I & II
Reinsulate Steam Mains	X	X	X	See Volumes I & II
Control Valves & Thermostats	X	X		See Volumes I & II
Economizers on A/C Units	X	X		See Volumes I & II
Central A/C	X	X		See Volumes I & II
Insul. Stm. Pipe in Bldgs.	X	X		See Volumes I & II
Boiler Economizers	X	X		See Volumes I & II
Blowdown Heat Recovery	X	X		See Volumes I & II
O2 Trim	X	X		See Volumes I & II
Energy Efficient Lighting	X	X		See Volumes I & II
Power Factor Adjustment			X	See Executive Summary Appendix
EMCS			X	See Executive Summary Appendix

ES-5.2 INCREMENT F

Operation and Maintenance projects that could be performed under Increment F for funding by the Facilities Engineer are listed below. An exact determination of the scope of most of the individual projects listed could not be established during the field study. Steam, electricity, and water systems have been turned off or disconnected in inactive buildings and/or plant areas. This made the actual testing of systems and components impossible.

- Test and repair or replace steam traps, leaking valves, valve stems, or packing. Steam traps, valves, etc., on inactive steam lines could not be checked for leaks or proper operation.
- Check piping, radiators, coils, refrigeration systems, compressed air systems, air handling systems, steam systems, water systems, and process equipment for plugs and leaks, and repair as necessary. Leaks and faults in energy distribution systems could not be established in non-functioning systems.

- Reduce domestic hot water temperatures, and install flow restrictors. Hot water temperatures would be set when systems in currently inactive buildings are started up and flow rates established.
- Install time clocks and/or manual timers to shut off exhaust fans and other items of equipment when their operation is not required. A determination must be made at the time of mobilization where time clocks or timers could be used.
- Relamp using low-wattage multivapor lamps in high bay areas on an as-required basis. Lamp replacement is a maintenance item.
- Install vestibules at high traffic entrances. Restrict normal usage to these entrances.
- Install low wattage lamps in fluorescent fixtures. This should be done as existing fixtures or ballasts are replaced, or new fixtures are added.

ES-5.3 INCREMENT G

The following projects are recommended, but do not qualify for ECAM funding: (See Volume II)

Inactive Facilities:

- Install steam control valves and thermostats (active and mobilization).
- Install overhead doors (active).

ES-6.0 PROJECT PRIORITY LISTING

A complete list of all projects studied and proposed, both qualifying and non-qualifying, is shown in Table ES-3. These projects are listed in descending order of their E/C Ratio. Each of these projects is listed with a brief description under "ECOs Studied - Increments A and B, Increment F, and Increment G". It should be understood that the energy savings for each project are not necessarily additive. Because the implementation of one project can affect the total savings of succeeding projects, the total actual savings will probably be less than the sum of all the individual projects.

ES-6.1 RECOMMENDED PROJECTS

The proposed projects listed in Table ES-3 were submitted to the Facilities Engineer at CAAP. Following his advice and recommendations, these projects were packaged into those projects which, individually or in a group, would be recommended for implementation. These projects are listed in Table ES-4 in descending order of priority. It was also determined that many of these projects could be implemented on a limited scale to increase

energy conservation in active buildings. The recommendations were, therefore, repackaged for active buildings under Current Operating Status. These projects are listed in descending order of priority in Table ES-5.

TABLE ES-3

LIST OF ALL PROJECTS STUDIED

PROJECT TITLE	$ COST CWE	SVGS. IN 10^6 BTU	B/C RATIO	E/C RATIO	SIMPLE PAYBACK YEARS	ACTIVE (1)	INACTIVE (2)
Install Boiler Economizers	112,600	34,814	11.1	281.1	1.1		X
Install Boiler Economizers	31,046	6,533	8.8	191.3	1.4	X	
Insulate Ceilings & Floors	1,070,100	110,771	3.7	94.1	3.3		X
Blowdown Heat Recovery	62,400	4,930	2.8	71.8	4.4		X
Reinsulate Steam Mains	31,500	1,929	2.5	55.7	5.0	X	
Boiler O2 Trim	220,400	11,932	1.9	49.2	6.4		X
Reinsulate Steam Mains	584,000	31,407	1.9	48.9	6.4		X
Insulate Dom.HW Htrs. & Piping	29,100	1,447	1.8	45.2	6.9		X
Insulate Stm. Pipe in Buildings	278,100	11,878	1.5	38.8	8.1		X
Boiler O2 Trim	55,883	2,084	1.6	33.9	8.0	X	
Blowdown Heat Recovery	18,628	670	1.5	32.7	8.3	X	
Caulk & Weather Strip	326,000	10,757	1.2	30.0	10.5		X
Steam Control Valves & Thermostats	1,037,000	30,155	1.0	26.4	13.2		X
Insulate Building Walls	3,497,000	70,597	.7	18.4	17.1		X
Install Overhead Doors - Caulk & Weather Strip	72,650	1,284	.7	16.1	16.9	X	
Return Steam Condensate	1,723,000	29,144	1.7	14.9	6.0		Z
Insulate Building Walls	206,456	3,244	.7	14.3	19.0	X	
Steam Control Valves & Thermostats	140,800	1,742	.5	11.2	28.1	X	
Install Storms & Vestibules	54,000	5,985	.4	9.8	36.8		X
Economizers on A/C Units	53,000	131	.3	2.2	39.1		X
Economizers on A/C Units	15,000	35	.2	2.1	45.2	X	
Central A/C	48,000	51	.1	1.0	79.8		X
Central A/C	21,000	6	.0	.3	296.2	X	
Install Storms & Vestibules	-PROJECT COMPLETED-					X	
Insulate Roofs	-PROJECT COMPLETED-					X	
Insulate Dom. H.W. Heaters & Piping	-PROJECT COMPLETED-					X	
Insul. Steam Piping in Bldgs.	-PROJECT COMPLETED-					X	
Low Wattage Lighting	-NOT RECOMMENDED - SEE VOLS. I & II TAB A					X	X
Power Factor Adjustment	-NOT RECOMMENDED - SEE VOLS. I & II TAB A					X	X
Install EMCS	-NOT RECOMMENDED - SEE VOLS. I & II TAB A					X	X

(1) Buildings which are occupied/in use during current status.
(2) Buildings which would be active, should mobilization occur.

TABLE ES-4
PROJECTS FOR IMPLEMENTATION ON MOBILIZATION (INACTIVE BUILDINGS)

PROJECT TITLE	$ COST	SAVINGS IN BTU X 10^6	B/C RATIO	E/C RATIO	SIMPLE PAYBACK YEARS	RECOMMENDED	NOT RECOMMENDED	ACTION
Install Boiler Economizers	112,600	34,815	11.1	281.1	1.1	X		See Volume II Tab D
Insulate Ceilings & Floors	1,070,100	110,771	3.7	94.1	3.3	X(1)		See Volume II Tab B
Blowdown Heat Recovery	62,400	4,930	2.8	71.8	4.4	X(1)		See Volume II Tab D
Boiler O2 Trim	220,400	11,932	1.9	49.2	6.4	X(1)		See Volume II Tab D
Reinsulate Steam Mains	584,000	31,407	1.9	48.9	6.4	X(1)		See Volume II Tab C
Insulate Domestic Hot Water Heaters & Piping	29,100	1,447	1.8	45.2	6.9	X(1)		See Volume II Tab C
Insulate Stm. Pipe in Bldgs.	278,100	11,878	1.5	38.8	8.1	X(1)		See Volume II Tab C
Caulk & Weather Strip	326,000	10,757	1.2	30.0	10.5	X(1)		See Volume II Tab B
Steam Control Valves & Thermostats	1,037,000	30,155	1.0	26.4	13.2	X(2)		See Volume II Tab E
Insulate Building Walls	3,497,000	70,597	.7	18.4	17.1		X(3)	See Volume II Tab A
Return Steam Condensate	1,723,000	29,144	1.7	14.9	6.0	X(1)		See Volume II Tab C
Install Storms & Vestibules	54,000	5,985	.4	9.8	36.8		X	See Volume II Tab A
Economizers on A/C Units	53,000	131	.3	2.2	39.1		X	See Volume II Tab A
Central A/C	48,000	51	.1	1.0	79.8		X	See Volume II Tab A

(1) Packaged for funding, should mobilization occur.
(2) Packaged for funding under Increment G.
(3) If SIR forms show this item will meet funding criteria, it would become a recommended project.

TABLE ES-5

PROJECTS FOR IMPLEMENTATION ON ACTIVE BUILDINGS

PROJECT TITLE	$ COST	SAVINGS IN BTU X 10^6	B/C RATIO	E/C RATIO	SIMPLE PAYBACK YEARS	RECOMMENDED	NOT RECOMMENDED	ACTION
Install Boiler Economizer	31,046	6,533	8.8	191.3	1.4	X(3)		See Volume I Tab D
Reinsulate Steam Mains	31,500	1,929	2.5	55.7	5.0	X(1)		See Volume I Tab B
Boiler O2 Trim	55,883	2,084	1.6	33.9	8.0	X(3)		See Volume I Tab D
Blowdown Heat Recovery	18,628	670	1.5	32.7	8.3	X(3)		See Volume I Tab D
Install Overhead Doors - Caulk & Weather Strip	72,650	1,284	.7	16.1	16.9	X(2)		See Volume I Tab C
Insulate Building Walls	206,456	3,244	.7	14.3	19.0		X(4)	See Volume I Tab A
Steam Control Valves & Thermostats	140,800	1,742	.5	11.2	28.1		X(5)	See Volume I Tab A
Economizer on A/C Units	15,000	35	.2	2.1	45.2		X	See Volume I Tab A
Central A/C	21,000	6	.0	.3	296.2		X	See Volume I Tab A

(1) Packaged for funding in FY 1986.

(2) Packaged for funding under Increment G.

(3) Packaged for funding in FY 1987.

(4) If SIR forms show this item will meet funding criteria, it would become a recommended project.

(5) Implementation using O&M funds should be considered.

ES-7.0 FUTURE EFFECTS ON ENERGY CONSUMPTION

ES-7.1 UNDER MOBILIZATION

Future energy consumption at Cornhusker AAP will depend upon whether the plant is mobilized and to what degree, the effectiveness of the ECO's implemented, as well as changes in mission.

For the purposes of this study, it was assumed that the plant was fully mobilized and production, and, therefore, energy consumption had increased 25 percent over the recent peak 1969 level. It was further assumed that the boiler plants were firing gas and using oil as a standby fuel.

No new construction was anticipated. Under mobilization, there is no relationship to AFEP year 1985, or year 2000 energy goals, because no points of comparison are available to the 1975 base year, since the plant was inactive that year.

ES-7.2 UNDER CURRENT STATUS

The plant is currently inactive and has been since mid-1974. Normalized energy consumption in FY1983 was reduced only to 90% of that used in 1975. Further reduction can be achieved by implementing the recommended projects.

CORNHUSKER AAP
GRAND ISLAND, NEBRASKA

FISCAL YEAR 1985 GOALS:

1. Installation energy consumption has been reduced by approximately 10%.
2. Average annual energy consumption per GSF has been reduced by approximately 10%.
3. No new buildings, that were part of the scope of this study, have been built and put into operation since 1975.

FISCAL YEAR 2000 GOALS:

1. Installation energy consumption has been reduced by approximately 10%. Further significant reduction can be achieved by implementing the recommended projects on active buildings.
2. Coal-fired boilers to reduce dependence on critical fuels was not a part of the Scope.
   A. Oil is used only as a standby fuel and to fire remote package boilers and furnaces.

*See Table ES-6, Page 22
and Figures I,II,III, and IV.

CORNHUSKER AAP
GRAND ISLAND, NEBRASKA

FUTURE USAGE

We would project energy consumption to drop to approximately 30,100.0 MMBtu after implementation of the recommended projects for active buildings.

	ESTIMATED SAVINGS
Insulate Steam Mains	1,929 x 10^6Btu
Caulk & Weather Strip, etc.	1,284 x 10^6Btu
Boiler Projects (Projected Overall Efficiency)	7,000 x 10^6Btu
Total Savings	10,213 x 10^6Btu
1983 Normalized Usage	40,300 x 10^6Btu
Saving at Implementation	10,200 x 10^6Btu
Projected Usage	30,100 x 10^6Btu

This projected usage translates to:

67% of the 1975 usage

67% of the 1975 Btu/GSF

TABLE ES-6
ACTUAL FUEL CONSUMPTION

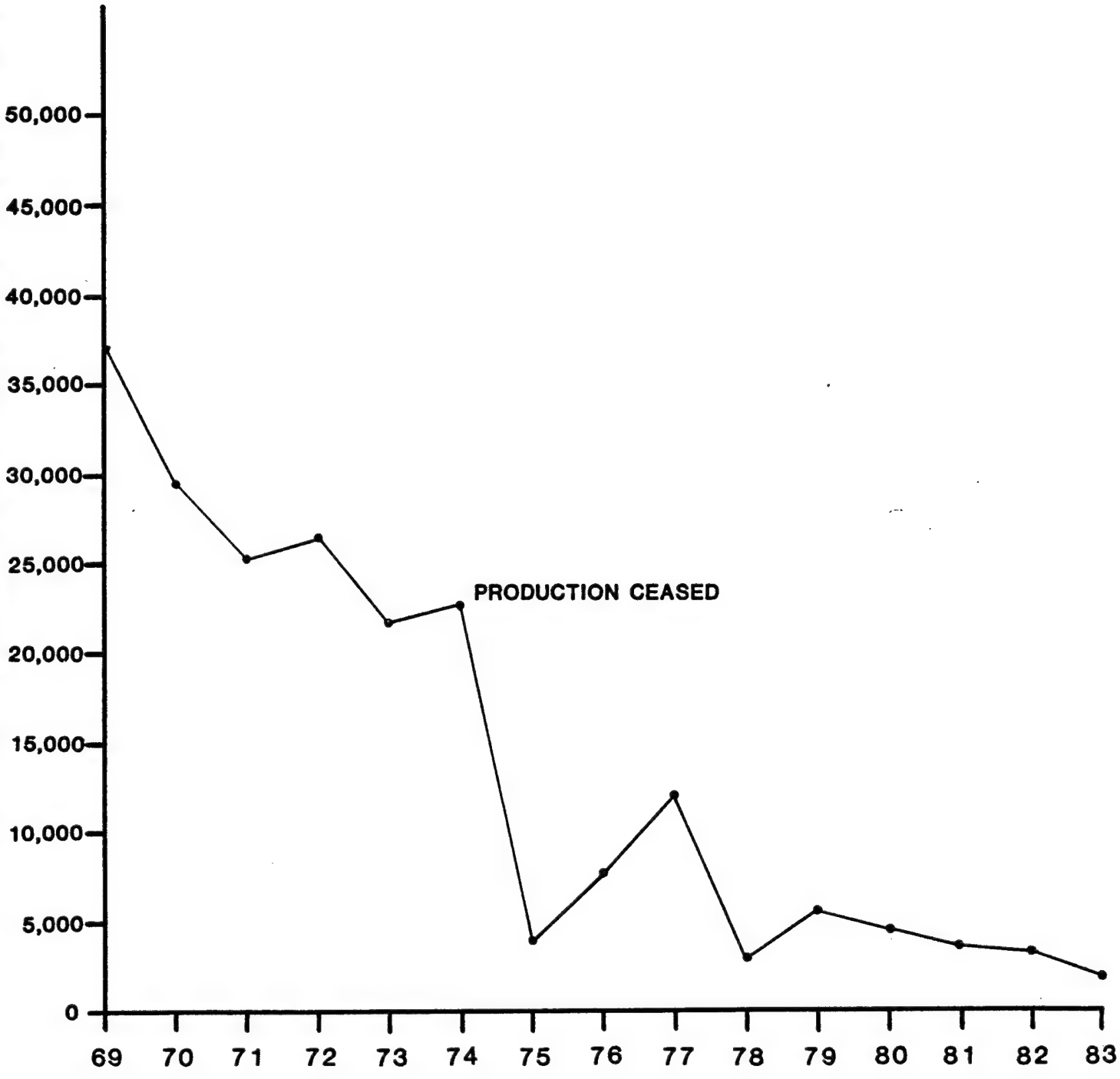
FISCAL YEAR	NO. 2 FUEL OIL GALLONS	NO. 2 FUEL OIL BTU X 10^6	NATURAL GAS MCF	NATURAL GAS BTU X 10^6	ELECTRICITY KWH	ELECTRICITY BTU X 10^6	TOTAL BTU X 10^6	% DF 1975 BASE
FY69	266,896	37,032.9	887,739	915,218.7	21,810,000	252,996.0	1,205,347.6	-
FY71	215,888	29,945.3	731,051	753,661.0	15,072,000	174,835.2	958,441.5	-
FY72	191,361	26,547.2	598,942	617,465.9	12,546,000	145,533.6	815,846.4	-
FY73	158,007	21,914.6	582,476	600,557.5	12,702.00	147,343.2	769,915.3	-
FY74(1)	165,061	22,899.4	66,258	68,355.3	2,208,000	25,612.8	116,867.5	-
FY75	28,292	3,925.2	24,936	25,671.9	1,308,000	15,172.8	44,769.9	100
FY76	55,899	7,753.3	17,126	11,630.1	1,182,000	13,711.2	39,094.6	87.3
FY77	87,016	12,066.9	11,297	11,650.3	952,500	11,049.0	34,766.2	77.6
FY78	23,115	3,204.0	21,953	22,578.9	1,120,500	12,997.8	38,780.7	86.6
FY79	40,448	5,603.5	24,056	24,805.8	1,603,785	18,604.1	49,013.4	109.5
FY80	35,473	4,923.8	19,548	20,104.5	1,684,500	19,540.2	44,568.5	99.5
FY81(2)	27,683	3,842.0	17,643	18,145.6	1,786,500	20,723.4	42,711.0	95.4
FY82(2)	26,727	3,703.3	18,609	19,176.6	1,704,000	19,776.4	42,656.3	95.3
FY83(2)	15,127	2,094.4	15,965	16,392.9	1,051,000	12,191.6	30,678.9	68.5(3)

(1) Production ceased in 1974.

(2) Consumption of fuel oil for heating is almost exclusively used for residences.

(3) Taking into account a mild winter and the ECO's implemented, a more "normalized usage" of approximately 90% of the base year would be more realistic.

Btu/GSF of Active Buildings (including Residences):
1975 44,769.9 x 10^6 ÷ 128,110 = 349,500 Btu/GSF
1983 Normalized 40,292.9 x 10^6 ÷ 128,110 = 314,500 Btu/GSF
Projected 30,000 x 10^6 ÷ 128,110 = 234,200 Btu/GSF

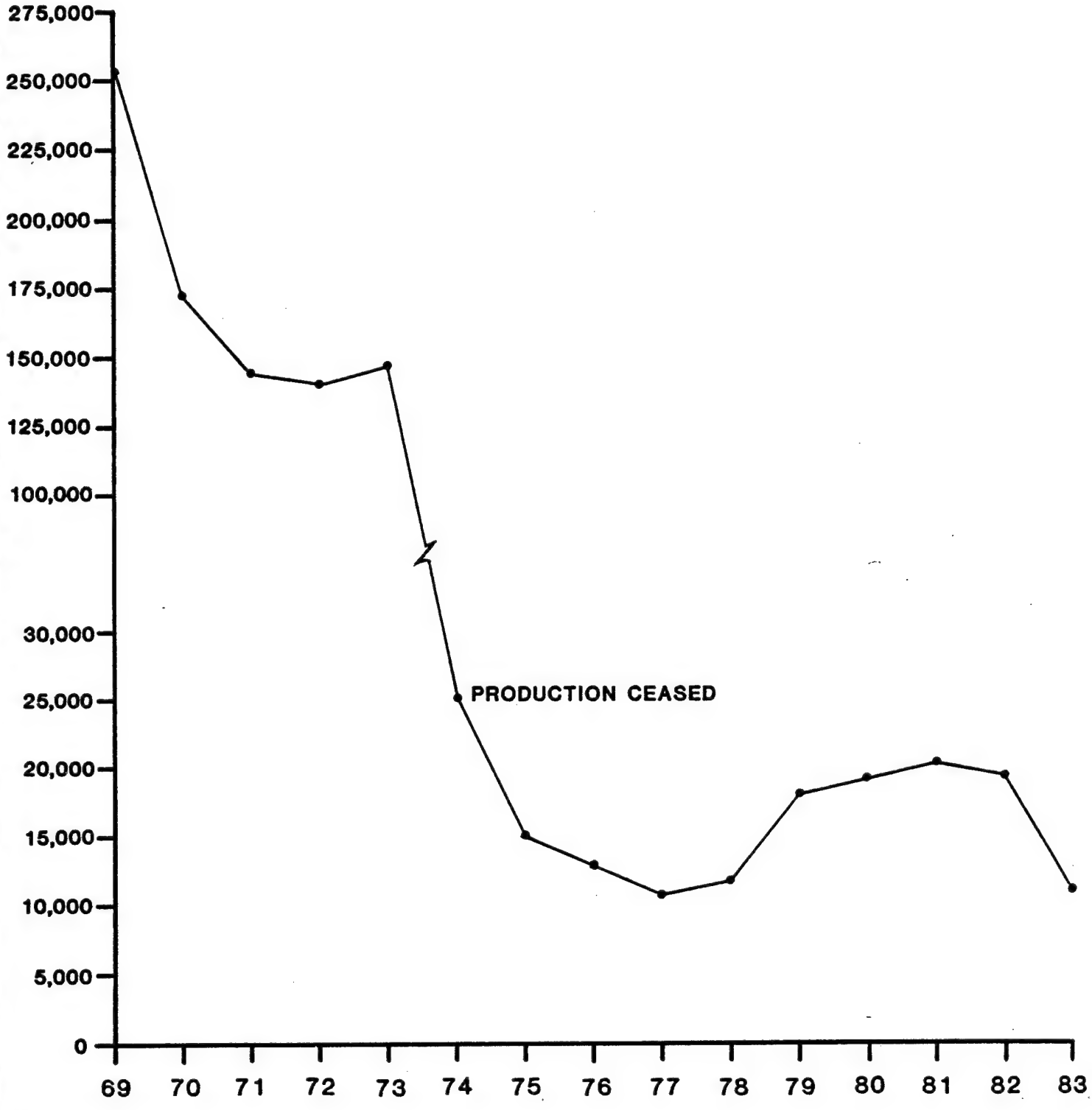


FISCAL YEAR CONSUMPTION OF OIL IN BTU x 10^6

(FOR HEATING & PROCESS ONLY)

FIGURE I

CORNHUSKER AAP
GRAND ISLAND, NEBRASKA

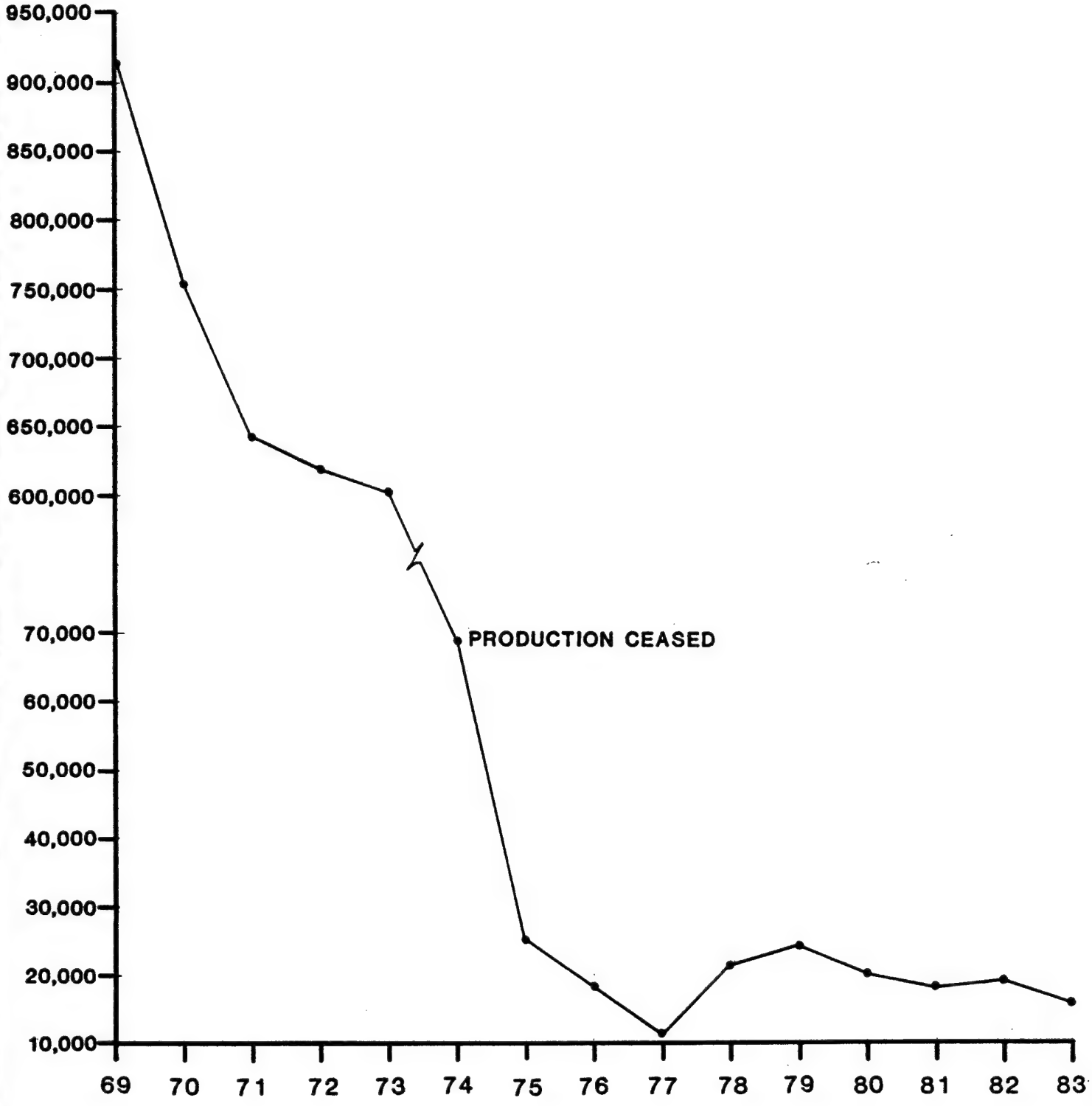


FISCAL YEAR CONSUMPTION OF ELECTRICITY IN BTU x 10^6

(FOR HEATING & PROCESS ONLY)

FIGURE II

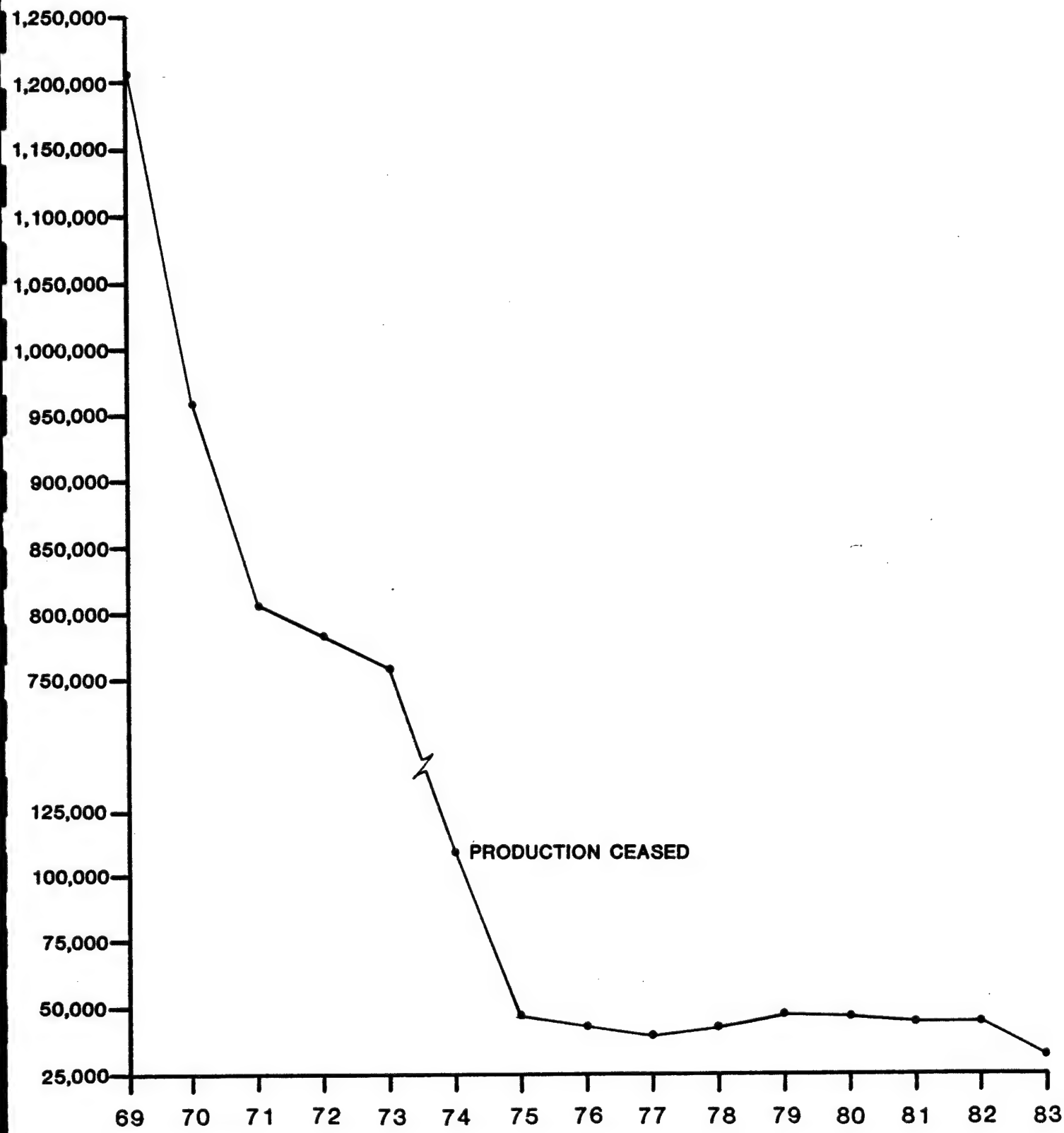
CORNHUSKER AAP
GRAND ISLAND, NEBRASKA



FISCAL YEAR CONSUMPTION OF GAS IN BTU x 10^6

(FOR HEATING & PROCESS ONLY)

FIGURE III



TOTAL FISCAL YEAR CONSUMPTION IN BTU x 10^6

(FOR HEATING & PROCESS ONLY)

FIGURE IV

ES-8.0 SUMMARY

Under current inactive status, the only remaining step to meet AFEP, DOD energy conservation goals is to further reduce energy consumption to meet Fiscal Year 2000 Goals. Significant energy conservation can be achieved if the recommended projects are implemented.

Energy savings that would be realized at mobilization have no real point of comparison to FY 1975. For this reason, the "Baseline Usage" was established. Estimated and actual savings, assuming mobilization, could then be compared with this base.

CORNHUSKER AAP
GRAND ISLAND, NEBRASKA

A P P E N D I X

ES-9.0

CORNHUSKER AAP
GRAND ISLAND, NEBRASKA

ANNEX A

ENERGY CONSERVATION OPPORTUNITIES:

Insulation - See Volume I Section A and Volume II Sections A and B.

Storm Windows - See Volume I Section A and Volume II Section A.

Caulk & Weather Strip - See Volume I Section C and Volume II Section B.

Insulated Panels - Not applicable to this project.

Solar Film - Not applicable to this project. The amount of on-site air-conditioning is minimal.

Vestibules - Vestibules are in use where needed on active buildings. See Volume II Section A.

Load Dock Seals - Not applicable to this project.

Reduction of Glass Area - The amount of glass at Cornhusker is not excessive.

Replace Kitchen Light Fixtures - Not applicable on this project.

Shut Down Hot Water Heater Energy - This was not considered feasible with gas water heaters.

Fluorescent Lighting - See Volume I Section A and Volume II Section A.

Reduce Lighting Levels - This has already been accomplished on Active Buildings. Lighting in Inactive Buildings is minimal.

Efficient Lighting Source - Multivapor lighting is recommended for relamping on an "as required" basis.

Improve Power Factor - See Volume I Section A and Volume II Section A.

High Efficiency Motors - The motors presently in use are limited and small, fractional horse power. Should mobilization occur, new equipment should include efficient motors.

Night Setback - See Volume I Section A and Volume II Sections A and E.

ANNEX A

ENERGY CONSERVATION OPPORTUNITIES: continued

Infrared Heaters - This was not considered feasible.

Economizer Cycles - See Volume I Section A and Volume II Section A.

Central Hot Water Circ. Pump - Circulating pumps are not used.

FM Radio Controls - Not applicable to this project.

Radiator Controls - See Volume I Section A and Volume II Section E.

Decentralized Hot Wtr. Htrs. - Hot water heaters are decentralized.

Shower Flow Restrictors - Not applicable to this project.

Heat Reclaim - The amount of refrigerant piping on this is minimal and mainly in small package units.

Reduce Air Flow - Heating is primarily by steam radiation. The air flow from air handlers in production areas would be set by ventilation requirements at the time of start-up.

Prevent Air Stratification - At the time of survey, ceiling fans were contemplated for installation in 1982. This project was, therefore, not considered.

Install Time Clocks - Time clocks and nightstats were included for applicable projects.

Boiler Oxygen Trim - See Volume I Section D and Volume II Section D.

Blowdown Heat Recovery - See Volume I Section D and Volume II Section D.

Revise Boiler Controls - See Volume I Section D and Volume II Section D.

CORNHUSKER AAP
GRAND ISLAND, NEBRASKA

ANNEX A

ENERGY CONSERVATION OPPORTUNITIES: continued

Chiller Controls - Not applicable; no chiller on site.

Chiller Replacement - Not applicable; no chiller on site.

Replace Absorption Chiller - Not applicable; no chiller on site.

Reduce Street Lighting - Lighting has been reduced to a minimum level in all areas.

Insulate Steam Lines - See Volume I Section B and Volume II Section C.

Return Condensate - See Volume II, Section C.

CORNHUSKER AAP
GRAND ISLAND, NEBRASKA

EMCS EVALUATION

Several factors were incorporated into the preliminary study for evaluation and recommendation of an EMCS for Cornhusker AAP:

1. The physical size of the facility spread over 11,936 acres.
2. The vast majority of buildings are heated only. The active buildings could be controlled more economically with night setback stats operating steam control valves.
3. The few air conditioned or partially air conditioned active buildings, less than 13%, would be more economically controlled by time clocks or night stats.
4. Most of the buildings would, under mobilization, probably be operated 24 hours a day.
5. Much equipment is currently missing, and it is impossible to determine exactly what would be installed at mobilization.

Because of the above factors, and the inactive status of the facility, a plant-wide EMCS could not be evaluated.

CORNHUSKER AAP
GRAND ISLAND, NEBRASKA

An EMCS for the few active buildings* is not recommended, because of its high cost and minimum use factor coupled with minimal savings and a poor E/C ratio.

Time clocks and night setback are, therefore, recommended for active buildings only, and incorporated in the ECOs evaluated.

*There are at present 21 active buildings. Eleven of these buildings are residences.

CORNHUSKER AAP
GRAND ISLAND, NEBRASKA

POWER FACTOR ADJUSTMENT

Power factor adjustment is not a feasible alternative for Cornhusker AAP. Analysis of recent utility bills, utility usage at mobilization, and the current rate structure reveals the following:

1. Reactive Energy charges are applied only if the power factor is below 80%. Above 90% there is a credit.
2. Recent utility bills show only a very small charge or, often, a credit for Reactive Energy.
3. Utility bills from the 1960s and 70s, when the plant was in operation, generally show a power factor in the 80 to 90% range.
4. The savings that would result from power factor adjustment on active buildings would be insignificant when compared to the high installation cost.
5. The savings at mobilization would be minimal also, especially if newer, more efficient equipment and motors were installed. Power factor adjustment could be reevaluated at that time.

MODIFICATION NO. P00001

CONTRACT NO. DACA45-81-C-0017

SCOPE OF WORK
FOR
ENERGY ENGINEERING ANALYSIS (EEA) PROGRAM

CORNHUSKER ARMY AMMUNITION PLANT, NE
BADGER ARMY AMMUNITION PLANT, WI;

25 September 1981

1. DESCRIPTION OF WORK. The Contractor shall:

1.1. Develop a systematic plan for the projects that will be developed to reduce energy consumption in compliance with the objectives set forth in the Army Facilities Energy Plan.

1.2. Use and incorporate applicable data and results of related studies, past and current, as feasible.

1.3. Develop a coordinated basewide energy study.

1.4. Prepare Project Development Brochures (PDBs), DD Forms 1391 and supporting documentation for feasible energy conservation projects.

1.5. Include all methods of energy conservation which are practical and determine the economic feasibility in accordance with guidance given.

1.6. List and prioritize all recommended energy conservation projects.

2. CONCEPT OF SCOPE ORGANIZATION.

2.1. The General Scope of Work is intended to apply to all military installations to be studied and to contain all general and common instructions and criteria. Detailed Scopes of Work for each installation will be used to modify and amplify the General Scope of Work as required to make it applicable to the installation.

2.2. Since funding will be incremental, it is necessary that work to be performed under this scope be specified in increments. Work has therefore been divided into five increments which briefly are: Increment A - ECIP projects for buildings and processes; Increment B - ECIP projects for utilities and energy distribution systems, Energy Monitoring and Control Systems (EMCS) and local use of available waste fuels in existing energy plants; Incorporated into Increment A and B (Increment G) - Identify maintenance repair and minor construction projects for energy conservation in addition to ECIP projects; Increment E - determine the feasibility of installing central boiler plants (pertaining to Badger A.A.P. only); Increment F - Facilities engineer conservation measures.

2.2.1. The five increments are divided into three phases:

A. Phase I - Data gathering and field trips.

B. Phase II - Analysis of data, identification of potential projects, feasibility and economic evaluation, and preparation of first page of DD Form 1391, including supporting data.

C. Phase III - Preparation of DD Form 1391 and Project Development Brochures (PDB) and preparation of a report presenting the results, analysis, and recommendations of the study. DD Form 1391 and PDB are not required for increments E and F.

2.2.2. There is a requirement for DD Form 1391 and PDB on all simple and readily justifiable energy conservation projects are to be submitted as early as possible, during Phase II.

2.2.3. It is anticipated that work in all three phases will be performed simultaneously after sufficient Phase I activity has occurred to allow Phase II and Phase III activities to begin.

3. GENERAL SCOPE OF WORK.

3.1. General.

3.1.1. A coordinated Basewide Energy Study Plan (E.E.A.P.) shall be accomplished. This study shall integrate the output of all energy conservation studies, projects, or designs which have previously been prepared or will be prepared under this contract. It is not intended to prescribe the details in which the studies are to be conducted or limit the Contractor in the exercise of his professional engineering experience, good judgment or investigative ingenuity. However, the information and analysis outlined herein are considered to be minimal essentials for adequate performance of the study. The Contractor will review the data contained in DoD Construction Criteria Manual 4270.1-M, and other data contained in Annexes to this Scope of Work. The Contractor shall develop a comprehensive approach to energy usage in the most efficient and economical manner for the proposed construction projects. The study shall include a comprehensive installation energy report documenting study methods and results.

3.1.2. The AE shall develop improvement projects that will reduce the energy consumption in compliance with the Army Facilities Energy Plan. All projects selected shall be ranked in order of highest energy-to-cost (E/C) ratio. ECIP projects must amortize within and have a payback period of less than their economic life. Projects which will disrupt the occupancy of a facility shall be grouped together and performed at the same time, if practical.

3.1.3. All methods of energy conservation which are reasonable and practical shall be considered, including operational methods and procedures as well as physical facilities. All energy conservation measures which produce energy or dollar savings shall be documented in the report. Any energy

conservation measures considered but eliminated shall be documented in the report with reasons for elimination. A checklist of energy conservation opportunities is included as Annex A to this scope. The items must be considered and the evaluation documented in the report. This list is not intended to limit or guide the AE but only to assure that basic and generally repetitive opportunities are addressed in the report.

3.1.4. The study shall include all energy consuming buildings, facility processes, and facility support of production processes, except those that use very little energy (i.e., storage areas) and those that are scheduled to be demolished. The work is reduced somewhat by building repetition, low energy use buildings and temporary buildings. The last, however, must be considered as having some extended use and will require coordination with demolition plans.

3.1.5. The Contractor shall consider building upgrading, but only if this work is incidental to the energy savings improvement, i.e., a better finish insulated wall panel may be used in lieu of the more expensive wall modification necessary to install insulation. Projects must meet ECIP criteria; building upgrading solely for appearance or similar consideration is not acceptable. Changes that should be made by Architect-Engineer or other organizations when designing new construction or modifying old construction that would minimize operating and maintenance cost of mechanical systems and minimize energy demand over the life of the facility shall be proposed.

3.1.6. In the course of field surveys, the Contractor shall document and report instances of waste in use and operation of facilities relative to energy consumption and shall recommend methods of reduction or elimination of these wastes, such as "provide operable windows," "abandon temporary building," or "convert temporary building room office to storage," "reduce excessive exhausting of conditioned air," etc., where it is an economically feasible and practical energy savings proposal. The Contractor should identify groups of buildings having centrally supplied heating and/or cooling in which energy consumption could be reduced by system or control revisions and make appropriate recommendations.

3.1.7. The "Energy Conservation Investment Program (ECIP) Guidance," dated 7 November 1977, and revised by message DAEN-MPO-U 291700Z Dec 80, shall be used for performing the economic analyses, except for construction cost escalation. Construction cost escalation shall be calculated using Table 4 of AR 415-17. The technological updating factor which applies to energy conservation projects (category code 82500) has been increased to 1.10. Additional guidance is contained in EIRS Bulletin 81-01, 8 February 1981, Inclosure 1, and subsequent editions when revised. "Engineering Instructions for Preparation of Feasibility Studies for Total Energy, Selective Energy and Heat Pump Systems," dated 1 July 1977, and changes thereto, shall be used for performing life cycle cost studies. The first addresses projected dates at the end of the fiscal year (FY) in which the project was programed and the end of the FY minus one, while the latter addresses dates of mid-point of construction, beneficial occupancy date (BOD), and BOD plus six months as times to which various cost figures are to be escalated.

Therefore, assume all improvement projects will be awarded in FY 84 (mid-point of construction about mid-point of FY 85, BOD about end of FY 85). The construction cost of ECIP projects must be equal to or greater than $100,000.

3.1.8. Data for major installations, subinstallations, satellites, and off-post facilities shall be separately documented.

3.1.9. The study shall include distribution and use of all energy sources. The energy sources include electrical, natural gas, liquefied petroleum gas, bulk oil, other oil products, steam when procured, gasoline, coal, etc. Natural gas distribution systems capacity shall not be expanded without authority from the MACOM headquarters.

3.1.10. The storage and distribution of heating and cooling media such as steam, hot water, chilled water, etc., will be documented under heating as described in TB ENG 353. Provisions to increase storage capacity for peak cooling and heating periods will be a part of this study. The city planning technique described in TB should be used where applicable.

3.1.11. The study will encompass the future population to be served. Military Aggregate Strengths published for use in master planning will be expanded by including all other personnel served, i.e., employees of all agencies on post, civilians, NAF, all Contractor personnel employed on the post, etc., plus military dependents and transient quarters and guest facility occupants. Methodology use to compute the population over a 20-year period will be provided within the study.

3.1.12. Computer modeling shall be used to incorporate field survey data, weather data, occupancy schedules, building construction data, energy distribution systems, and equipment data into a model of the typical buildings and total base energy use. The computer shall be used to develop load profiles, calculate energy savings, and evaluate possible energy conservation measures such as shading, building mass, and solar. The computer model shall be capable of analyzing the energy requirements of buildings; performance of heating, cooling, and ventilating equipment; energy distribution systems; and energy conversion equipment. The computer model shall be verified against historical energy use or temporary metering installed by the AE, and adjusted as required until reasonable agreement is obtained (typically within 10 percent). Computer or hand calculations methods may be used in combining the requirements of building groups, systems, and equipment efficiencies to obtain the basewide total energy use. Unless the BLAST (Building Loads Analysis and Systems Thermodynamic) program is used, the AE shall submit a sample computer run example with an explanation of all input and output data and summary of program methodology and energy evaluation capabilities.

3.1.13. A list of simple and successful energy conservation opportunities with standard approved calculation methods and data format is included as Annex B. The standard forms shall be used to develope those items, which are appropriate, into projects.

3.2. Project Management.

3.2.1. Project Manager. The Contractor shall designate a project manager to serve as a single point of contact and liaison for all work required under the contract. Upon the award of the contract, individual shall be immediately designated in writing.

3.2.1.1. District Office Project Manager. A project manager designated by the Contracting Officer will serve as the point of contact within the Omaha District Office.

3.2.2. Installation Assistance. A project engineer designated by the Commanding Officer at each installation will serve as the point of contact for obtaining available information and assisting in establishing contacts with the proper individuals and organizations as necessary in the accomplishment of the work required under this contract.

3.2.3. Public Disclosures. The Contractor shall make no public announcements or disclosures relative to information contained or developed in this contract, except as authorized by the Contracting Officer.

3.2.4. Conferences. Conferences will be scheduled after each submittal, except final reports. Periodic meetings may be scheduled whenever requested by the Contractor and approved by the Contracting Officer for the resolution of questions or problems encountered in the performance of the work. The Contractor's appropriate representatives(s) shall be required to attend and participate in all conferences pertinent to the work required under this contract as directed by the Contracting Officer. All resulting travel costs and expenses incurred for these conferences will be paid for in accordance with Article 3B of the Articles of Service.

3.2.5. Site Visits, Inspections, and Investigations. The Contractor, consultants, if applicable, and/or designated representative(s) thereof shall visit and inspect/investigate the site of the project as necessary and required during the preparation and accomplishment of the work. All resulting travel costs and expenses incurred are included in the lump sum price of the contract.

3.2.6. Records. The Contractor shall be required to maintain and provide upon request a record of all communications relative to this contract in which the Contractor and/or the designated representative(s) participated.

3.2.6.1. The Contractor shall be required to provide a record of all significant conferences, meetings, discussions, verbal directions, telephone conversations, etc., relative to this contract in which the Contractor and/or designated representatives thereof participated. These records shall be dated and shall identify the contract number, and modification number if applicable, participating personnel, subject discussed and conclusions reached. The Contractor shall forward to the Contracting Office, as soon as possible (not to exceed ten (10) calendar days) a reproducible copy of the records.

3.2.6.2. The Contractor shall be required to provide a record of requests for and/or receipt of Government-furnished material, supplies, data,

documents, information, etc., which if not furnished in a timely manner, would significantly impair the normal progression of work under this contract. The records shall be dated and shall identify the contract number and modification number, if applicable. The Contractor shall forward to the Contracting Officer, as soon as possible (not to exceed ten (10) calendar days), a reproducible copy of the record of receipt.

3.2.7. Interviews. The Contractor shall conduct entry and exit interviews before and after surveys with the Facilities Engineer and Contracting Officer's representative.

3.2.7.1. Entry. The entry interviews shall thoroughly brief and describe the intended procedures for the study.

3.2.7.2. Exit. The exit interview shall include a thorough briefing describing the items surveyed, problems encountered, energy conservation measures requiring little analysis and evaluation which the Facilities Engineer can implement readily.

3.3. Services and Materials. All services, supplies, materials (except those specifically enumerated to be furnished by the Government), plant, labor, superintendence and travel necessary to perform the work and render the data required under this contract are included in the lump sum price of the contract.

3.4. Phases of Work.

3.4.1. Phase 1 shall consist of gathering data and inspection of facilities in the field. These activities must be closely coordinated with the Contracting Officer, the Installation Commanders and the Facilities and Plant Engineer Representatives. In addition to examination of physical facilities, plans, records and prior studies, the Contractor shall observe operating procedures and methods. Data sources should be identified and assumptions clearly stated and, if necessary, adequately justified.

3.4.1.1. The Contractor shall compile quantitative lists of all raw energy consumed annually, and population and facilities served thereby, as related to and required for energy analysis, to include, but not limited to:

a. Production cycles.

b. KW hours of electricity and peak demands.

c. Therms of gas by type (NG, LNG, propane, etc.).

d. Gallons of oil by grade.

e. Other, if any (such as purchased steam, chilled water, coal, refuse derived and waste oil fuel, etc.).

f. Personnel and building occupancies.

g. Weather data.

h. Total energy usage for fiscal year 1975 shall be collected or estimated by calculations to provide reference base for use by the facility.

3.4.1.2. The Contractor shall become thoroughly familiar with each installation and undertake all necessary field trips to obtain required data. Where there are a number of similarly constructed buildings performing the same function, a representative sample may be analyzed. Proposed future construction through FY 87 shall be considered. Buildings shall be listed and identified by the installation's numbering system and also by function and title. The building list shall contain items relating to and required for energy analysis and shall include, but not limited to:

a. Square footage of floor area (heated and/or air conditioned space).

b. Type of construction and "U" values.

c. Window area and door openings (include dock doors).

d. Type and capacity of HVAC systems.

e. Type and capacity of domestic water and process water heating systems.

f. Building heat gain and heat loss.

g. Types of energy entering the buildings with estimated or metered consumption expressed in BTU for development of load profiles.

h. Estimated or documented electrical demand (KW) and electrical energy consumption (KWH/yr.).

i. Process energy systems.

3.4.2. Phase II shall consist of analysis of data, performance of feasibility and economic studies, identification of proposed projects, and preparation of first page of DD Forms 1391. During this phase, all potential energy conservation measures which produce energy and/or dollar savings should be identified and evaluated as to technical and economic feasibility. Energy conservation measures determined to be technically and economically feasible shall be combined into projects and ranked according to highest E/C ratio. All simple and readily justifiable energy conservation projects shall be submitted as early as possible, with programming documents.

3.4.3. Phase III shall consist of the preparation of the programming documents (complete DD Forms 1391 and PDB's) and reports presenting the results and recommendations of the study for each installation.

3.5. Increments of Work.

3.5.1. Increment A projects involve modifying, improving or retrofitting existing buildings, including family housing and energy distribution systems, and mechanical plants to include architectural and structural features, HVAC systems, solar systems, plumbing systems, interior or exterior building and parking facilities lighting. Projects shall be economically evaluated in accordance with provided ECIP criteria. Programming documents are required for those projects meeting ECIP criteria.

3.5.1.1. (Survey.) Each type of building or discrete part thereof shall be analyzed in terms of its energy consumption and load profile. List all buildings by type of function (barracks, warehouse, office, etc.) and identify specific characteristics affecting rate of energy consumption. Show "U" value for each major building component, i.e., roof, ceiling, exterior walls, floor, windows and doors. Show building heat gain, if air conditioned, and heat loss, if heated, in terms of BTUH at the design temperature differential. Each significant architectural and structural element, and each functional activity and process should be identified and its effect on the building energy consumption established. In order to accomplish this, population levels, functional activities and durations, historical and concurrent dry and wet bulb temperatures, etc., must be determined, and electrical demand and consumption shall be estimated and load curves developed.

3.5.1.2. (Evaluations.) Identify each energy source entering the building, estimate the BTUs of each energy source (in Mega BTU) consumed per year, the type of energy and BTUs used for domestic water heating, the type of energy and BTUs used for comfort heating, the type of energy and BTUs used for comfort cooling. Describe the types of mechanical systems and their major components. Electrical demand and consumption shall be estimated and load curves developed. An energy (or heat) balance should be developed for each type of building at times of maximum usage or crucial functional activity. Identify building or equipment changes or modifications that would minimize energy demands in existing facilities for the life of the building not to exceed 25 years. Provide firm data to support recommendations.

3.5.1.3. (Recommendations.) The Contractor shall collect and present in tabular and/or graphic form a complete energy consumption picture of the entire base for the operating procedures and conditions. Planned physical plant expansion with its expected population growth shall be included. The Contractor shall analyze each element of an energy balance statement and make specific recommendations for improving performance. Changes to use remote sensors and thermostats in mechanical rooms or control of return air could prove fruitful. Proposals which would be technically and economically feasible but which would hinder or obstruct functional activities should be flagged for early resolution. Changes in system temperatures and flow rates should be identified and evaluated.

Heat pump systems should be considered where there is a simultaneous requirement for both heating and cooling in a building or buildings in close proximity of one another.

3.5.1.4. (As a portion of Increment A,) the Contractor shall evaluate facilities which are determined to have high energy consumption to determine which would benefit from the installation of appropriate types of meters. The resulting recommendation shall include location by building number, and sizes and types of meter to be installed. These facilities will include, but not be limited to family housing, production, maintenance, storage and administration buildings.

3.5.1.5. If a promising application of solar energy is identified during Increment A, the Contractor shall make a recommendation for a detailed analysis.

3.5.2. Increment B projects involve utilities and energy distribution systems, EMCS for building and distribution systems, and conversion of existing energy plants. Projects shall be economically evaluated in accordance with ECIP criteria. Programming documents are required (DD Form 1391 and PDB's) for those projects meeting ECIP criteria.

3.5.2.1. Systems to be studied will include electrical supply and distribution systems; steam, chilled water and hot water distribution systems including wells, pumps, storage and treatment facilities; and sewage collection and treatment facilities which are maintained and operated by the installation. Quantitative analyses of all energy distribution systems shall be made. Efficiency or coefficients of performance shall be determined for each type of system, i.e., the ratio of energy (or fuel) input to energy use or rejection. If possible, load profiles for each type of system should be developed reflecting annual, monthly, weekly, daily and hourly consumption as appropriate. The information obtained from the survey of existing and proposed facilities shall be used to the fullest possible extent in developing the requirements the EMCS.

3.5.2.2 Develop a load profile by year for the past three years for each energy source procured (heating oil, natural gas, LP, electrical). The load profile charts with supporting data will be submitted for review by the Government. The accuracy of these time related charts will influence the final recommendations made by the Contractor.

3.5.2.3. Project energy costs three years from date of contract award and develop heating and cooling costs and lighting and other loads per square foot per year.

3.5.2.4. Energy Monitoring and Control System (EMCS). The Contractor shall determine the feasibility of an EMCS for building electrical, mechanical and utility distribution systems. The intent of this study is to determine the basic conceptual architecture of the EMCS to the extent that primary economic calculations can be made to determine feasibility per ECIP criteria. The documentation shall be of sufficient accuracy to insure that future project design calculations that will be done after EEAP completion, will not deviate more than 20 percent from the EEAP submittal.

3.5.2.4.1. The Contractor shall survey all buildings and shall perform feasibility evaluations in accordance with guidance in HNDSP-80-013-ED-ME. The standard evaluation forms contained therein shall be a part of the submittal. EMCS analysis and evaluations shall be developed using TM 5-815-2. Any existing EMCS project or any currently understudy shall be considered and evaluated for integration. EMCS evaluations shall consider but not be limited to the following features.

a. Start/stop Programs.
   Scheduling.
   Duty cycling.
   Load shedding for electrical demand limiting lighting control.
   Start/stop Optimization.

b. Ventilation and Recirculation Program.
   Enthalpy economizer.
   Dry bulb economizer.
   Outside air reduction.

c. Temperature Reset Programs.
   Space temperature night setback.
   Hot and cold deck.
   Reheat coil.
   Chilled water.
   Chiller plant optimization.

d. Labor Savings/Monitoring.
   Example: Boiler plant monitoring
   (EMCS logging of points which at present are manually logged.)

3.5.2.4.2. Recommendations. The Contractor's recommendations for an EMCS shall be in sufficient detail to define the system configuration, approximate quantity and types of control instruments, sensors, and data transmission system. The selection of points to be monitored and controlled shall be given priority based upon ECIP criteria. Development of Data Transmission System shall follow the procedures stated in ETL 1110-3-318. The control system functions, expected energy reduction, and monetary savings (including the manner in which these savings are to be achieved) shall be explained.

3.5.2.4.3. At those installations where certain buildings cannot be economically connected to an EMCS, an alternate means of control shall be evaluated. The use of FM radio control and current carrier control for military family housing is an example. The alternate control shall be interfaced to an existing or proposed EMCS.

3.5.2.4.4. The Contractor shall prepare and provide recommendations in narrative form. Input/Output (I/O) summary tables shall be prepared and provided for each system selected in EMCS in accordance with HNDSP-80-013-ED-ME. Cost Estimates shall be prepared and provided in accordance with HNDSP-80-013-ED-ME (Table II) for the mechanical and electrical modifications required to implement the EMCS.

3.5.2.4.5. Inoperative controls shall be noted with cost estimates to repair and replace as described in HNDSP-80-013-ED-ME.

3.5.2.4.6. Labor savings/monitoring shall be included, provided the E/C and benefit/cost (B/C) ratios are not affected to the extent of jeopardizing the ECIP requirements.

3.5.2.5. Existing energy plants shall be studied to determine the condition of existing equipment, efficiency of the plant equipment, operational procedures, adequacy of plant capacity, etc. Recommended energy conserving modifications shall be determined.

3.5.2.6. As a result of the data gathered and analyzed, the Contractor shall develop graphic presentations, i.e., graphs, charts, etc., depicting the hourly kilowatt demand for peak load/demand days for each type of building area with the exception of those which have little or no loads. This data shall be utilized to develop procedures to reduce the peak demand and accommodate load shedding.

3.5.2.7. If a promising application of solar energy is identified during Increment B, the Contractor shall make a recommendation for detailed study.

3.5.3. Increment G (Incorporate into Increment A and B) Projects are those feasible energy saving projects developed in Increments A and B which do not qualify under ECIP criteria.

3.5.3.1. Identification of Increment G projects for energy conservation will be accomplished during Phase I and Phase II of Increments A and B. All projects including low cost items will be documented based on energy savings, energy/cost ratio, benefit/cost ratio, manhours to accomplish project and estimated cost. Projects will be listed in order of highest E/C ratio.

3.5.3.2. Economic analysis will be based on ECIP procedures. DD Form 1391 and Project Development Brochures (PDB) will be required. Complete PDB is not required. Only the pertinent information required by the PDB format is necessary. The report shall contain all back-up data and shall present the information so as to permit the installation to easily update the economic evaluations. The requirements of AR 415-15 and AR 415-35 shall be followed for major and minor construction projects respectively. For maintenance and repair projects, the requirements of DA Pamphlet 420-6 and AR 420-10 will be followed. Prior to preparing programming documents, the contractor shall review all proposed projects with the facilities engineer. In lieu of DD Forms 1391 and PDB's, work orders or local projects may be prepared if so desired by the facilities engineer.

3.5.4. Increment E, Central Boiler Plant Projects. Determine the feasibility of installing central boiler plants serving all or discrete parts of the Badger A.A.P., WI. If the information gathered at the initial site investigation indicates that further centralization of existing plants is impractical, the Contractor shall notify the Contracting Officer that a central plant analysis does not appear feasible and submit supporting information. If the Contracting Officer agrees that a central plant study is

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not feasible after reviewing the information an engineering report and economic analysis of converting the existing central plant(s) to solid fuels shall be prepared instead of a central plant analysis. Programming documents are not required.

3.5.4.1. A study shall be made to determine the practicability and economic feasibility of constructing central boiler plants to supply steam or high temperature water, as applicable, to all or discrete parts of Badger AAP. The study shall evaluate, including economic analysis, a single boiler plant serving the entire facility. If there are probable advantages to multiple plant(s) serving a discrete part of the facility, these concepts shall be analyzed as alternates to a single plant concept. The primary objective is to reduce the dependency on petroleum fuels by changing to coal or other solid fuels as the primary fuel with oil as the backup or secondary fuel. The use of solid fuel such as refuse derived fuels, and wood as a fuel or as a supplemental fuel to coal shall be considered. Existing distribution and building systems will be utilized to the maximum practical extent. The study shall assume that all practical energy conservation measures developed by the Basewide Energy Studies would have been accomplished except for cogeneration and solid waste plants. The study shall include site recommendations and shall consider sources of refuse derived fuels, wood, and coal supply, transportation methods, fuel handling and storage and pollution control methods.

3.5.4.2. Economic Analysis shall be based upon life cycle costing procedures. Any savings or increase in energy consumption shall be documented. The condition and life expectancy of existing central boiler plants shall be considered and documented. The report shall contain sufficient data and present the information so as to permit the installation to easily produce these programming documents, if so desired, by extracting technical and economic data and updating the economic evaluations.

3.5.5. Increment F.

3.5.5.1. The purpose of the work under this increment is:

a. To provide recommendations for modifications and changes in system operation which are within the Facilities Engineer funding authority and management control.

b. To summarize and prioritize all energy conservation measures and projects from Increments A, B, F, and G for the use of the Installation Commander and Facilities Engineer in developing their energy management plans.

3.5.5.2. Recommendations For Modifications: The intent is to provide these recommendations in the form of specific, practical instructions for the use of the Facilities Engineer personnel. For planning purposes, each recommendation shall include manhours, labor and material cost to accomplish, and dollar and energy savings which it will produce.

3.5.5.3. Facilities Engineer Funding Authority. Only modifications which fall within the Facilities Engineer funding authority and management control shall be described in detail as outlined in paragraph 3.5.6.7. It is anticipated that most modifications will be relatively low cost and well under the Facilities Engineer funding approval limits which, in general terms, are $100,000 for alteration type work and $500,000 for maintenance and repair type work. If there are any individual work items which exceed these amounts, they shall only be listed, with a brief description.

3.5.5.4. Level of A/E Effort. The site surveys under this increment shall be performed by Senior Mechanical, Electrical and Energy Conservation Engineers. There are a large number of buildings and systems to be examined and it would be too costly and time consuming to do a detailed analysis of each. In order to make the maximum use of limited time, a great deal of experienced judgement must be employed to determine the required length and depth of analysis of each system.

3.5.5.5. Previous Studies/Increment. The A/E personnel performing work under this increment shall become thoroughly familiar with all other increments and any previous energy studies prior to commencing site work.

3.5.5.6. Buildings and Systems to be Surveyed. A site specific list of buildings and systems to be surveyed is appended to this scope.

3.5.5.7. The A/E shall describe all recommended energy conserving modifications to system equipment or operation in the following format:

a. Brief description of reasons for the modification.

b. Specific instructions for accomplishing modifications.

c. Estimated man-hours and labor and material cost. Man-hours to be listed by trade.

d. Estimated dollar and energy savings.

3.5.5.8. At the conclusion of the site survey the A/E shall prepare a rough draft of the recommended modifications and schedule a meeting to discuss them with the Facilities Engineer in order to obtain his input and advice.

3.5.5.9. The A/E shall list and date all energy conservation modifications accomplished by the installations since 1975.

3.5.5.10. The A/E shall summarize all costs, man-hours, dollar savings and energy savings for modifications in this increment. They shall be listed in order from highest to lowest E/C ratio.

3.5.5.11. The A/E shall check the installation master plan for all planned facilities changes, list them and provide an energy use estimate for each. This estimate shall be based on average figures for that type of facility.

3.5.5.12. The A/E shall list all projects in Increment A, B, and G from highest to lowest E/C ratio.

3.5.5.13. The A/E shall describe any energy related areas of operation in which he determines additional training of Facilities Engineer personnel is required. The specific type of training shall be described. Specific Government or commercial courses shall be listed, with cost and duration, whenever possible. The A/E shall recommend only those commercial courses with which he is familiar. It is understood that it is the Government's responsibility to make a final determination as to the acceptability of the course. The A/E shall contact Huntsville Division Training Office (205) 895-5039 for information on Government furnished training. Training necessitated by recommended modifications shall be included.

3.5.5.14. The A/E shall describe expendable equipment which should be changed to a higher efficiency type at the next replacement. A specified detailed description for the use of the installation procurement office shall be furnished. The AE shall provide three (3) manufacturers which meet the specifications for the equipment recommended.

3.5.5.15. Explanatory Notes:

a. General. Special attention should be directed towards electrical consumption. Opportunities to reduce it by means of load programers, timers, programmable timers, reduction of constant volume air flow and conversion to variable volume air flow should not be overlooked.

b. Reference paragraph 3.5.6.3. Any specific questions concerning Facilities Engineer authority shall be directed to the Facilities Engineer during the site survey.

c. Reference paragraph 3.5.6.7. It is inevitable that some recommended modifications will already be known to the Facilities Engineer. These will be described by the A/E exactly as all others. This Scope is intended to produce one comprehensive list, with back-up data, based on energy considerations.

d. Reference paragraph 3.5.6.7. These modifications may ultimately be performed by Facilities Engineer or contract personnel. This does not affect the format described.

e. Reference paragraph 3.5.6.9. This serves as a check list of items which do not appear as recommended modifications because they have already been done.

f. Reference paragraph 3.5.6.7 and 3.5.6.10. The summary of man-hours by trade is intended to provide Facilities Engineer with back-up information to determine staffing required to accomplish Energy Conservation.

g. Reference paragraph 3.5.6.10, 3.5.6.11 and 3.5.6.12. The summaries of potential energy savings from Increment A, B, and G projects, Increment F modifications, and the energy impact of Master Plan changes is intended to

show the Facilities Engineer and Installation Commander the possibilities available to meet energy reduction goals.

h. EMCS. These are as prone to design, construction and operational problems as any other systems. They shall be inspected in the same manner as other systems during the site survey.

i. Central Plants. Central heating and cooling powerplants are to be included in this increment. There are undoubtedly some significant low cost modifications that can be made in these areas.

4. SUBMITTAL OF DATA.

4.1. Organization of study report. A table of contents and index shall be included. Tabs and/or dividers shall clearly and distinctly divide sections, subsections, and appendices. The report shall be arranged in the following manner:

- Executive Summary. Shall be separately bound. See Annex C for minimum requirements for the executive summary.
- Narrative report. Contains executive summary and data for all increments studied. May be more than one volume. Increment "F" shall be included in narrative report and also bound separately.
- Appendix. Contains detailed calculations and reference material.
- Separately bound items. Programming documents, sample computer outputs, completed survey forms, and etc.

4.2. Programming Documents. Military Construction Project Data (DD Forms 1391), supporting documentation and Project Development Brochures shall be prepared as required. Early identification of feasible projects and development of the corresponding DD Forms 1391 are essential and shall be accomplished as required by this Scope of Work. DD Forms 1391, supporting documentation and Project Development Brochures shall be submitted simultaneously, in accordance with the required submittal schedule. Joint-funded projects require multiple programming documents.

4.2.1. Military Construction Project Data (DD Form 1391). These documents shall be prepared in accordance with AR 415-15 and supplemental requirements as stated below. These forms shall be separate from the report. They shall be bound similarly to the report in a manner which will facilitate repeated disassembly and reassembly. A complete DD Form 1391 shall be prepared for each project. The form shall include a statement that project results from EEAP study. Projects which will disrupt the occupancy of a facility shall be grouped together and performed at the same time, if economically feasible and practical. Documents shall be complete as per requirements of submission to higher Department of Army headquarters. These programming documents will require signatures by the proper installation

officials prior to submittal of the required quantities. To facilitate ECIP project approval, the following supplemental requirements shall be provided:

a. In title block clearly identify projects as "ECIP."

b. Include complete description of all work to be accomplished.

c. Provide a comprehensive list of buildings affected. Include building numbers, quantity, utilization, square feet floor area, and indicate temporary or permanent (i.e., #522-525 4 P Admin 20,000 sq. ft.).

d. Give references or sources of calculation procedures and list assumption used.

e. Attach detailed energy and cost saving calculations. Include any increased use of energy or costs resulting from the retrofit action.

f. Attach the economic summary analysis form.

g. On the DD Form 1391 state the estimated dollar savings, MBTU savings, simple amortization, B/C and E/C ratios.

h. On the DD Form 1391 include a statement affirming that "all buildings/systems will be in active use throughout the amortization period."

4.2.2. Project Development Brochures: Preparation of Project Development Brochures requires the Contractor to delineate the functional requirements of the project as related to the specific site. The Contractor shall prepare PDB's in accordance with AR 415-20 and TM 5-800-3, Program Development Brochure. Some projects may not require all the forms and checklists included in the TM. Only that information needed for the project shall be included. The PDB-1 format described in the TM shall be used for whatever information is needed. The PDB-11 may be deleted if so directed by the Conracting Officer.

4.3. Presentation and Submittals. The Contractor shall give a brief presentation of each submittal to installation, command and other Government personnel. A comprehensive review of the report will be conducted immediately following the presentation. During the presentation, the personnel in attendance shall be given ample opportunity to ask questions and discuss any changes deemed necessary to the study. It is anticipated that each presentation and review will require approximately one working day. The presentation will be on date(s) and at location(s) directed by the Contracting Officer.

4.3.1. Preliminary Submittal. The Contractor shall prepare and submit the preliminary submittal at the completion of Phase I. The contractor shall submit the Scope of Work for the installation studied, and the minutes of the

prenegotiation meeting, as an appendix to the submittal. The purpose of this submittal is to insure that the work is being performed on schedule. The Contractor shall indicate what actions have been accomplished to date, the methods of approach utilized, progress to date, and justifications for the studies and approaches; reveal problems encountered or resulting from the survey; present information the Contractor considers pertinent; and obtain approval or redirection of the study as required.

4.3.2. Interim Submittal. The Contractor shall prepare and submit the interim submittal upon completion of Phase II. The Contractor shall submit the Scope of Work for the installation studied, and the minutes of the prenegotiation meeting, as an appendix to the submittal. This submittal shall contain a narrative summary of the conclusions and recommendations together with all raw and supporting data, methods used, and sources of information. The summary shall include the order of priority in which the recommended tasks should be accomplished. The Contractor shall separately identify feasible projects meeting ECIP criteria and shall submit preliminary first page of DD Forms 1391, including supporting documents. During the review period, the Contracting Officer's Representative will coordinate with installation and MACOM representatives and provide the Contractor with direction for packaging projects for programming purposes.

4.3.3. Prefinal Submittal. The Contractor shall prepare and submit the prefinal submittal essentially (90%) of all work under this contract is complete. The Contractor shall submit the Scope of Work for the installation studied, and the minutes of the prenegotiation meeting, as an appendix to the submittal. The report shall contain a narrative summary of conclusions and recommendations together with all raw and supporting data, methods used, and sources of information. The report shall integrate all aspects of the study. The summary shall include the order of priority in which the recommended tasks should be accomplished. Revised/completed program documents shall be included. The program documents shall be complete and ready for signature by the installation commander.

4.3.4. Final Report. The Contractor shall submit the final report when the required work is 100% complete. The Contractor shall submit the Scope of Work for the installation studied, and the minutes of the prenegotiation meeting, as an appendix to the submittal. The final report shall incorporate all changes resulting from the previous submittal and associated reviews. The report shall cover the entire scope of the study and shall include the order of priority in which the recommended tasks shall be accomplished.

4.4. Review comments for submittals. The submittals will be reviewed by appropriate Government agencies to evaluate content and determine accuracy. Written comments will be furnished to the Contractor by the Contracting Officer. These comments will be discussed in detail during the presentation and review period. The Contractor shall provide written notification of action on each comment to all reviewing agencies within three (3) weeks after the review meeting. Intentions of noncompliance with any comment shall be substantiated in detail. The Contractor shall document any comments on the presentations. Authorization to proceed with the next phase will be granted

with or after the Contracting Officer's approval of the Contractor's intended actions on the review comments.

4.5. Resubmittals of Inadequate Documents. The Contracting Officer may require a resubmittal of any document(s), if such document(s) are not approved because they are determined by the Contracting Officer to be inadequate for the intended submittal purpose.

4.6. Submittal Quantities and Schedule. Time allowed for preparation and submission of the information and/or documents required by this contract are exclusive of documented Government review time. Government review time for a submittal is the period of time from the documented date of receipt of the submittal by the Government until the documented date of receipt by the Contractor of the Contracting Officer's authorization to proceed with the work for the next submittal.

Each report and/or submittal shall be furnished in the following quantities:

Document	Quantity	Received
Phase I	20 Sets	
Phase II, Interim Report/ Preliminary Submittal	20 Sets	
Phase III, Advanced Final Submittal	20 Sets	
Final Submittal	20 Sets	

5. DETAILED SCOPES OF WORK. (NOT USED)

6. PERIOD OF SERVICE. Expeditious completion of each phase and increment of this contract is essential to the accomplishment of the energy conservation goals.

7. SCHEDULING AND REPORTING PROGRESS. The Contractor shall prepare and submit an activity diagram or schedule which will indicate individual activities, significant events and milestones along with schedule dates for each. The schedule shall cover the entire scope and work period of the contract. In addition, the Contractor shall submit monthly reports of progress. These reports may be in letter or chart form and should be worded or keyed to indicate progress on the activity diagram.

8. GOVERNMENT-FURNISHED DATA. The following data and criteria are furnished initially to the Contractor for guidance. Deviation from the criteria will be permitted only when actual field conditions or other factors require such a change. Propose deviation with justification shall be submitted to the Contracting Officer for approval.

a. DOD Construction Criteria Manual, DOD 4270.1-M, Advance Edition, dated 1 June 1978.

b. Energy Conservation Investment Program (ECIP) Guidance (included in AFEP).

c. DAEN-MPE Multiple Address letter, dated 12 July 1979, subject: Progress Chart, Field Data Forms, and Report Format for Energy Analysis Projects (Base Wide Energy Studies).

d. ETL's 110-3-243, 256, 266, 271, 282, 294, 296, 302, 309 and Tech Note 77-2.

e. Architect-Engineer Instruction Manual, dated August 1977.

f. Omaha District Standard Legend Sheet (1 Mylar).

g. Location Plan for each installation (1 Mylar each).

h. Base Utility Systems Information maps for each installation (By each Installation).

i. AR 415-15.

j. TB ENG 353.

k. HNDSP-80-013-ED-ME.

l. Engineering Instructions for Preparation of Feasibility Studies for Total Energy, Selective Energy, and Heat Pump Systems; dated 1 July 1977.

m. TM 5-801-1.

n. TM 5-800-3.

o. TM 5-815-2.

p. Building Information Schedule (Manual) (By each Installation).

q. Utility Procurement Records (Including Reimbursables) (By each Installation).

r. Facilities Engineering Technical Data Report (By each Installation).

s. Army Facilities Energy Plan.

t. Military Aggregate Strengths (By Installation).